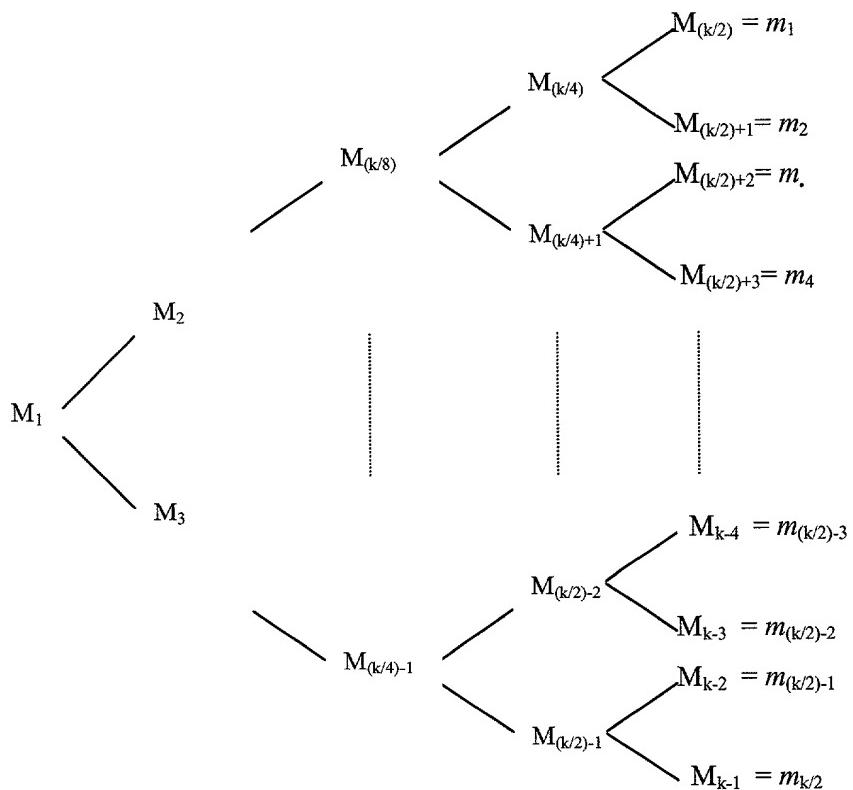


PARTIAL READ AND WRITE PATH DATA FLOW  
IN A DIRECT ACCESS STORAGE DEVICE

FIG. 1  
(Prior Art)



**FIG. 2**

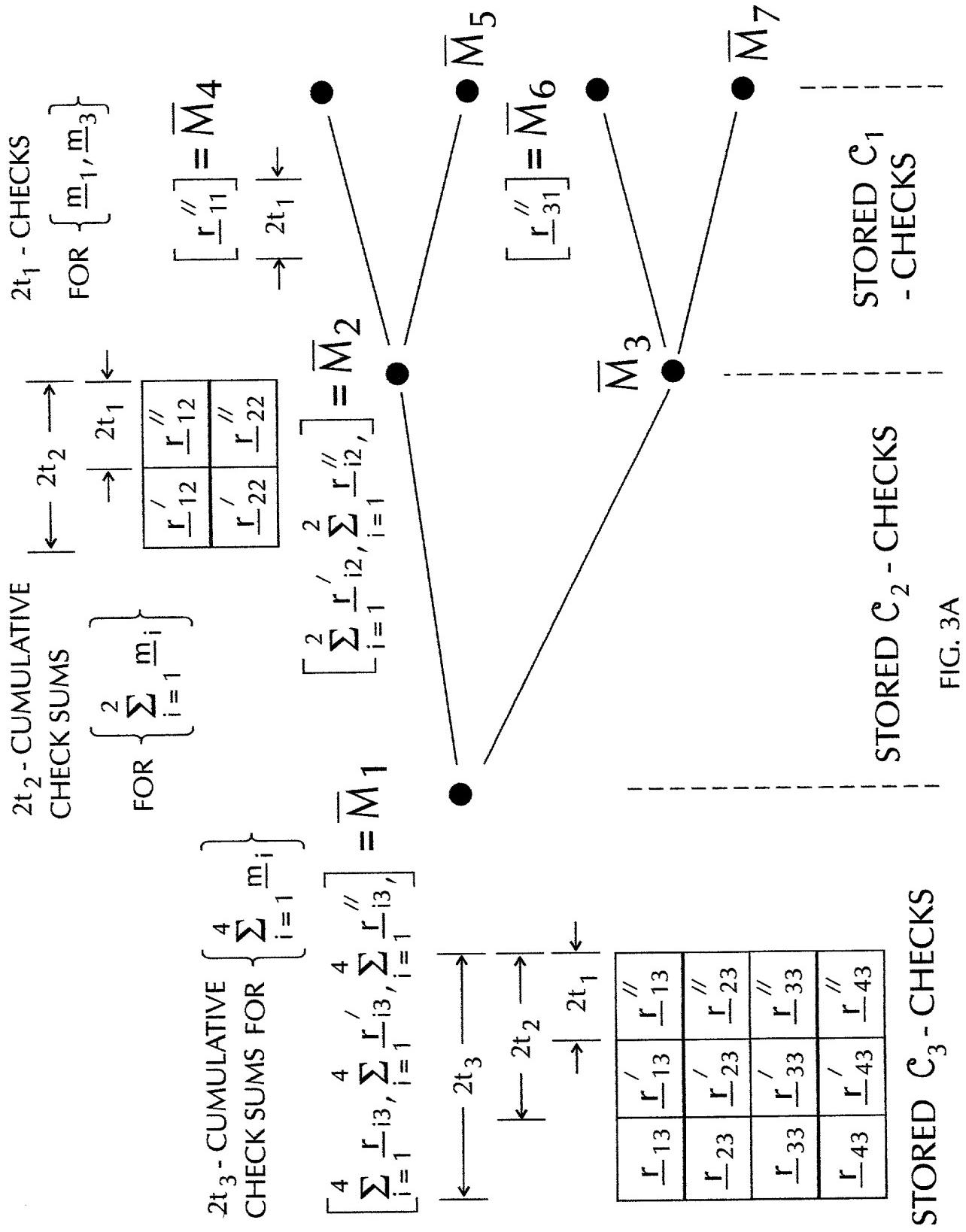


FIG. 3A

## MULTI-LEVEL ENCODER

$$\bar{M}_4 =$$

$\frac{\underline{r}_{11}''}{\underline{r}_1}$	$\underline{r}_1 \Rightarrow$	$\underline{m}_1$	$\underline{r}_1$
--	-------------------------------	-------------------	-------------------

$$\bar{M}_2 =$$

$\frac{\sum_{i=1}^2 r'_{i2}}{r_a}$	$r_2 \Rightarrow$	$\underline{m}_2$	$\underline{r}_a$	$\underline{r}_2$
------------------------------------	-------------------	-------------------	-------------------	-------------------

$$\bar{M}_6 =$$

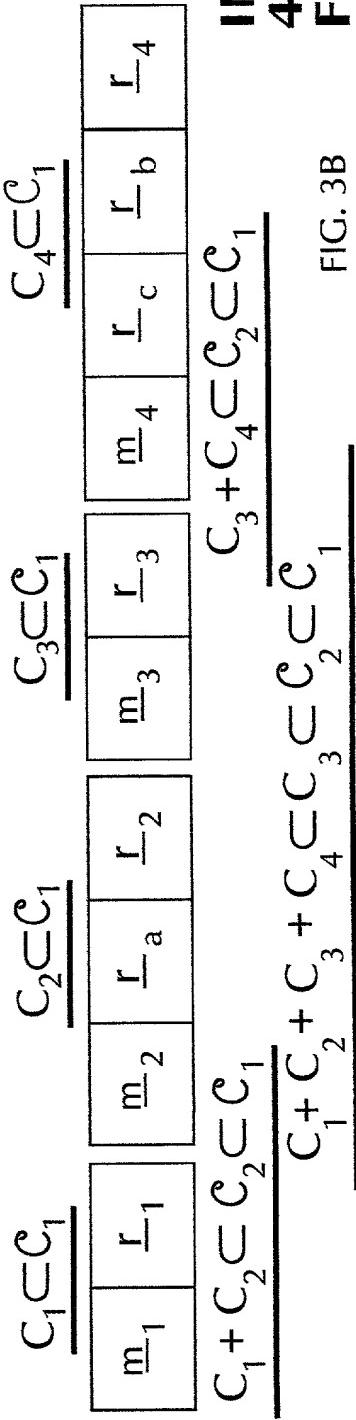
$\frac{\underline{r}_{31}''}{\underline{r}_3}$	$\underline{r}_3 \Rightarrow$	$\underline{m}_3$	$\underline{r}_3$
--	-------------------------------	-------------------	-------------------

$$\bar{M}_1 =$$

$\sum_{i=1}^4 r_{i3}$	$\sum_{i=1}^4 r'_{i3}$	$\sum_{i=1}^4 r''_{i3}$
-----------------------	------------------------	-------------------------

$$\underline{r}_c \quad \underline{r}_b \quad \underline{r}_4 \Rightarrow$$

$\underline{m}_4$	$\underline{r}_c$	$\underline{r}_b$	$\underline{r}_4$
-------------------	-------------------	-------------------	-------------------



## CHECK EQUATIONS

$$\underline{r}_1 = \underline{r}_{11}''$$

$$\underline{r}_a = \sum_{i=1}^2 \underline{r}'_{i2}, \quad \underline{r}_2 = \underline{r}_{11}'' + \sum_{i=1}^2 \underline{r}_{i2}''$$

$$\underline{r}_3 = \underline{r}_{31}''$$

$$\begin{aligned} \underline{r}_c &= \sum_{i=1}^4 \underline{r}_{i3}, \quad \underline{r}_b = \sum_{i=1}^2 \underline{r}'_{i2} + \sum_{i=1}^4 \underline{r}'_{i3} \\ \underline{r}_4 &= \underline{r}_1 + \underline{r}_2 + \underline{r}_3 + \sum_{i=1}^4 \underline{r}_{i3}'' \end{aligned}$$

**INTEGRATED  
4-SECTOR  
FORMAT**

FIG. 3B

### 2t<sub>2</sub> - CUMULATIVE CHECK SUMS

$$\bar{M}_2 = \left[ \sum_{i=1}^2 r'_{i2}, \sum_{i=1}^2 r''_{i2} \right]$$

2t<sub>3</sub> - CUMULATIVE SYNDROME SUMS FOR

$$\left[ \sum_{i=1}^8 r_{i3}, \sum_{i=1}^8 r'_{i3}, \sum_{i=1}^8 r'''_{i3} \right] \bar{M}_1$$

$\leftarrow 2t_3 \rightarrow$

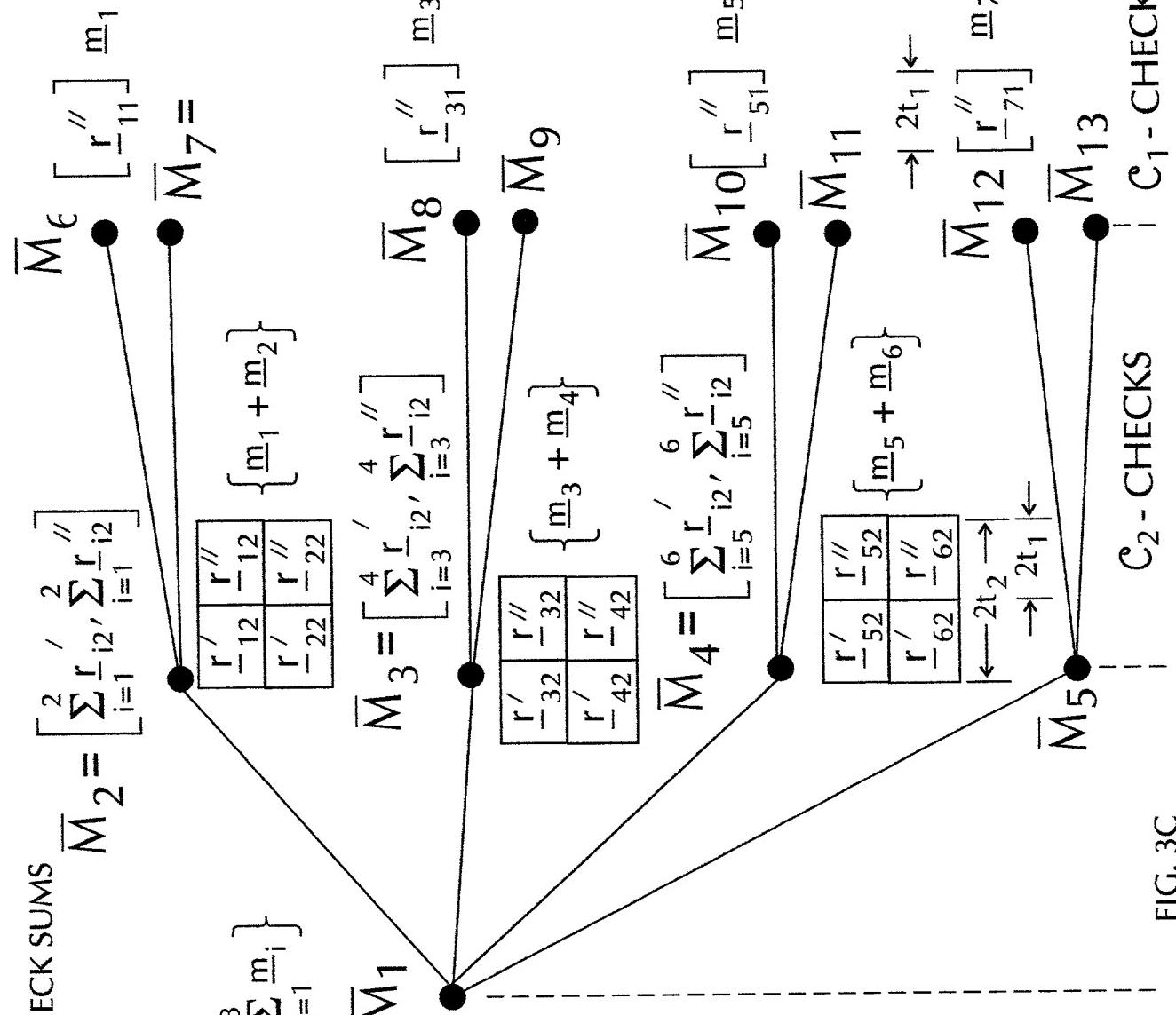
$\leftarrow 2t_2 \rightarrow$

$\rightarrow 2t_1 \leftarrow$

$r_{13}$	$r'_{13}$	$r''_{13}$
$r_{23}$	$r'_{23}$	$r''_{23}$
$r_{33}$	$r'_{33}$	$r''_{33}$
$r_{43}$	$r'_{43}$	$r''_{43}$
$r_{53}$	$r'_{53}$	$r''_{53}$
$r_{63}$	$r'_{63}$	$r''_{63}$
$r_{73}$	$r'_{73}$	$r''_{73}$
$r_{83}$	$r'_{83}$	$r''_{83}$

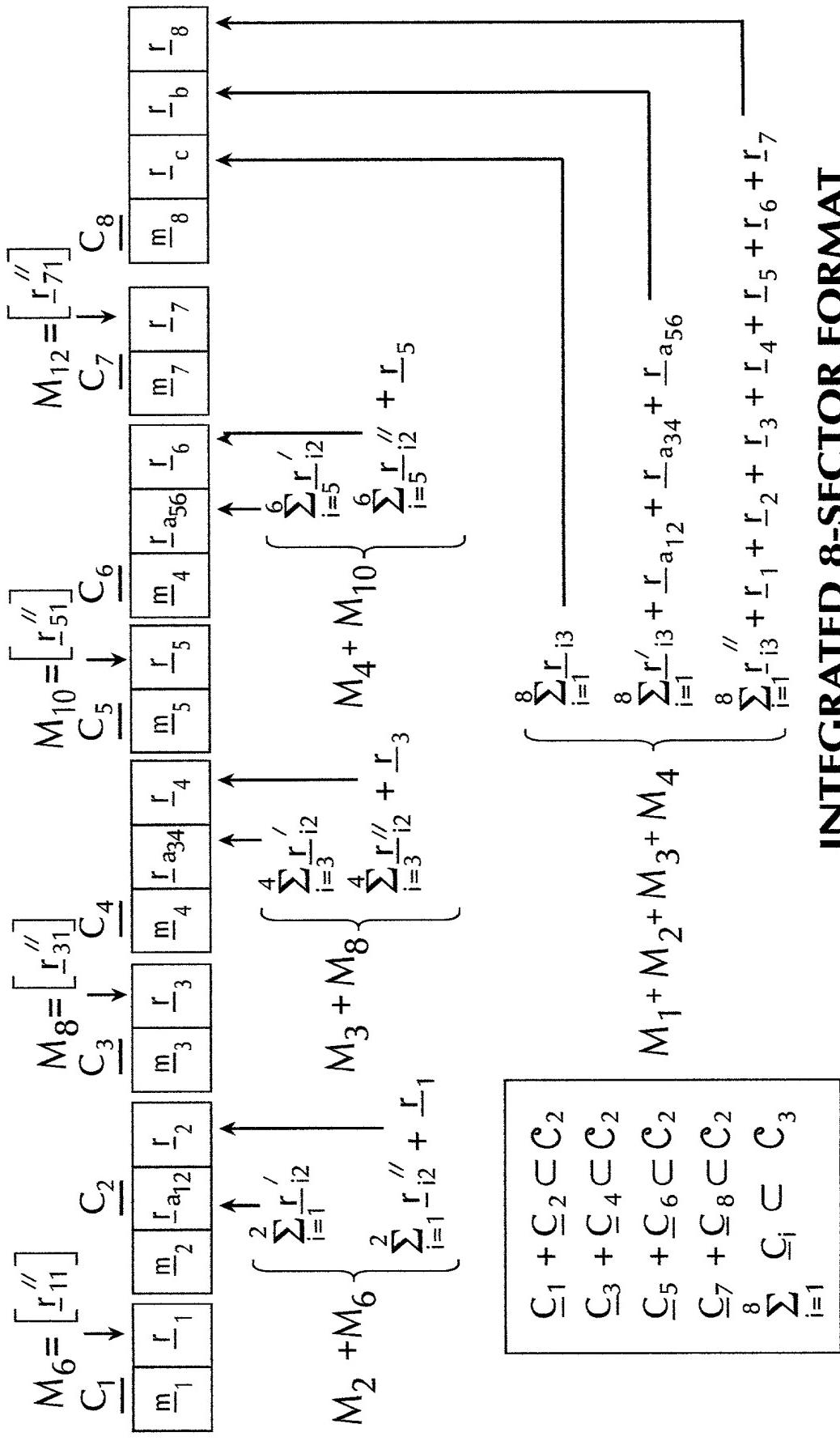
C<sub>3</sub>-CHECKS

FIG. 3C



C<sub>2</sub>-CHECKS | C<sub>1</sub>-CHECKS

## MULTI-LEVEL ENCODER CHECK EQUATION



**INTEGRATED 8-SECTOR FORMAT**

$$C_3 \subset C_2 \subset C_1$$

FIG. 3D

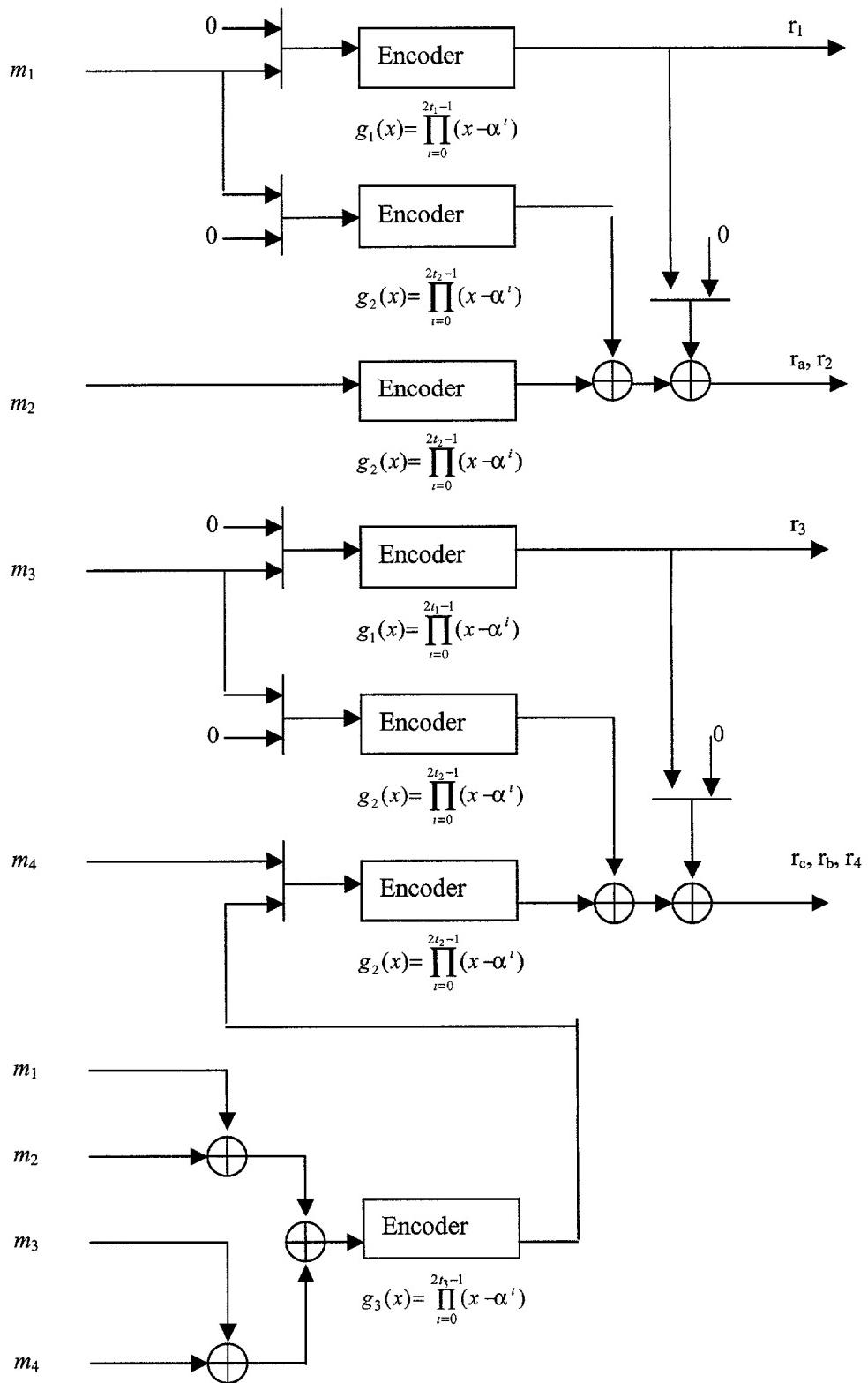
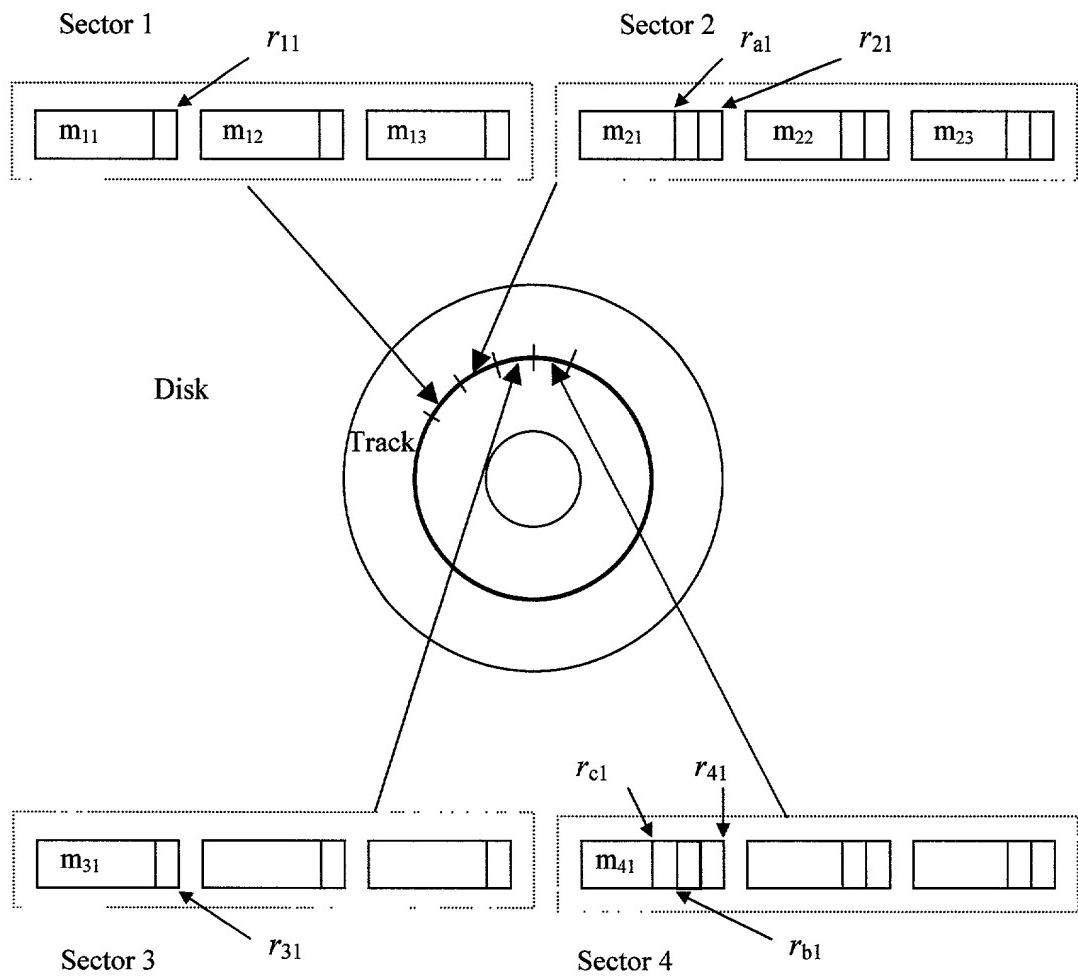


FIG. 4



**FIG. 5**

# MULTI-LEVEL SYNDROME GENERATOR

2t<sub>2</sub> - CUMULATIVE  
SYNDROME SUMS FOR

$$\bar{M}_2 = \left[ \sum_{i=1}^2 \underline{S}'_{i2}, \sum_{i=1}^2 \underline{S}''_{i2} \right], \sum_{i=1}^2 \tilde{C}_i$$

2t<sub>1</sub> SYNDROMES FOR

2t<sub>3</sub> - CUMULATIVE  
SYNDROME SUMS FOR

$$\underline{S}_{13}, \underline{S}'_{13}, \underline{S}''_{13}$$

$$\underline{S}_{23}, \underline{S}'_{23}, \underline{S}''_{23}$$

$$\underline{S}_{33}, \underline{S}'_{33}, \underline{S}''_{33}$$

$$\underline{S}_{43}, \underline{S}'_{43}, \underline{S}''_{43}$$

$$\underline{S}_{12}, \underline{S}'_{12}, \underline{S}''_{12}$$

$$\underline{S}_{22}, \underline{S}'_{22}, \underline{S}''_{22}$$

$$\underline{S}_{32}, \underline{S}'_{32}, \underline{S}''_{32}$$

$$\underline{S}_{42}, \underline{S}'_{42}, \underline{S}''_{42}$$

$$\underline{S}_1, \underline{S}'_1, \underline{S}''_1$$

$$\underline{S}_2, \underline{S}'_2, \underline{S}''_2$$

$$\underline{S}_3, \underline{S}'_3, \underline{S}''_3$$

$$\underline{S}_4, \underline{S}'_4, \underline{S}''_4$$

$$\underline{S}_{13}, \underline{S}'_{13}, \underline{S}''_{13}$$

$$\underline{S}_{23}, \underline{S}'_{23}, \underline{S}''_{23}$$

$$\underline{S}_{33}, \underline{S}'_{33}, \underline{S}''_{33}$$

$$\underline{S}_{43}, \underline{S}'_{43}, \underline{S}''_{43}$$

$$\underline{S}_{12}, \underline{S}'_{12}, \underline{S}''_{12}$$

$$\underline{S}_{22}, \underline{S}'_{22}, \underline{S}''_{22}$$

$$\underline{S}_{32}, \underline{S}'_{32}, \underline{S}''_{32}$$

$$\underline{S}_{42}, \underline{S}'_{42}, \underline{S}''_{42}$$

$$\underline{S}_1, \underline{S}'_1, \underline{S}''_1$$

$$\underline{S}_2, \underline{S}'_2, \underline{S}''_2$$

$$\underline{S}_3, \underline{S}'_3, \underline{S}''_3$$

$$\underline{S}_4, \underline{S}'_4, \underline{S}''_4$$

$$\bar{M}_4 = \left[ \underline{S}_1'', \underline{S}_2'' \right], \tilde{C}_1$$

$$\bar{M}_5 = \left[ \underline{S}_2'', \underline{S}_3'' \right], \tilde{C}_2$$

$$\bar{M}_6 = \left[ \underline{S}_3'', \underline{S}_4'' \right], \tilde{C}_3$$

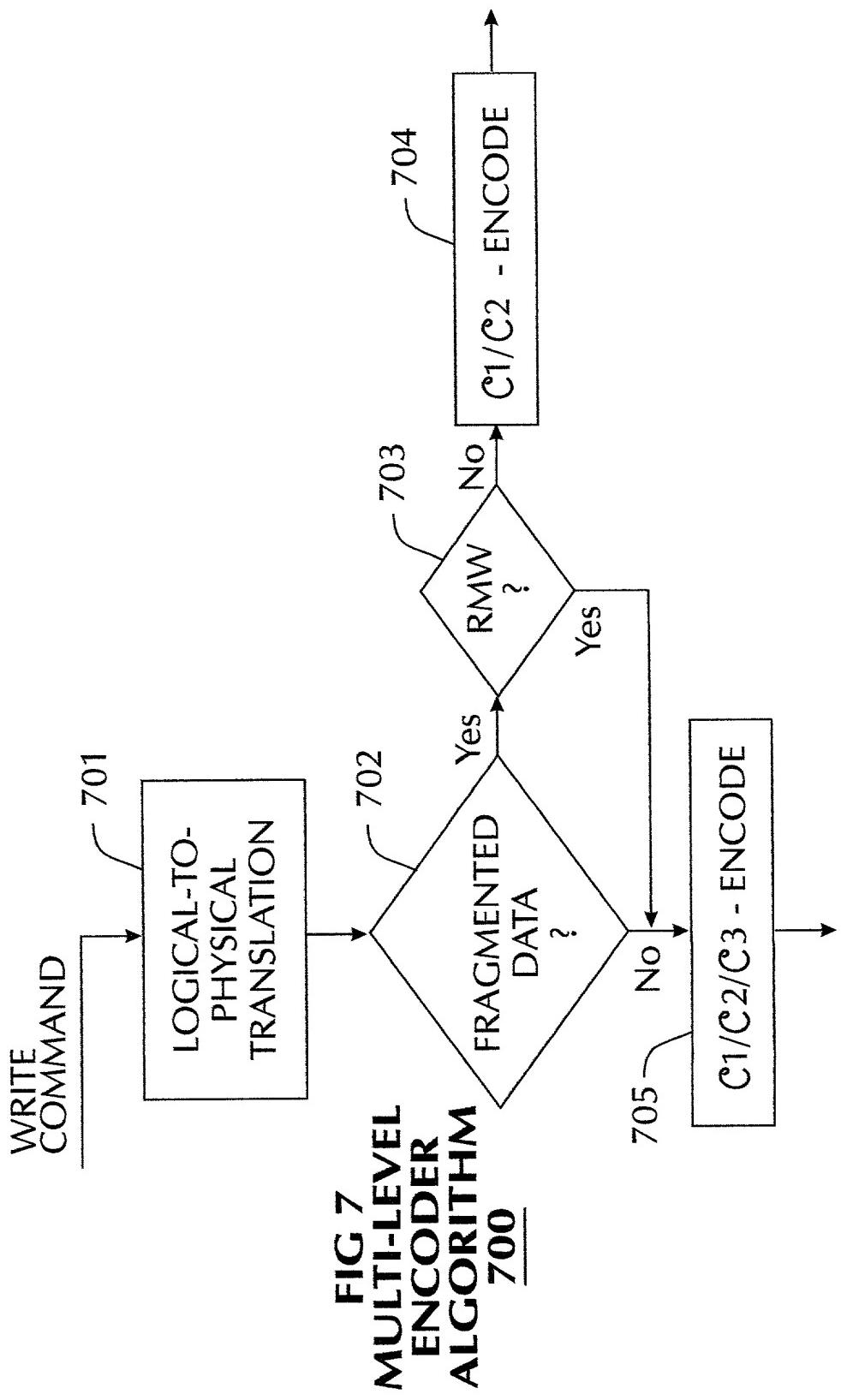
$$\bar{M}_7 = \left[ \underline{S}_4'', \underline{S}_1'' \right], \tilde{C}_4$$

STORED C<sub>3</sub>  
- SYNDROMES

STORED C<sub>2</sub>  
- SYNDROMES

STORED C<sub>1</sub>  
- SYNDROMES

FIG. 6



**FIG. 8  
MULTI-LEVEL  
DECODER  
ALGORITHM  
800**

